

Title: Three-Dimensional Electrical Device Packaging Employing Low Profile  
Elastomeric Interconnection  
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### **CLAIMS**

- 1 1. A three-dimensional electrical device package for compactly packaging  
2 vertically-spaced electrical devices, comprising:  
3 a plurality of vertically-spaced electrical devices;  
4 a layer of anisotropic conductive elastomer (ACE) electrically interconnected  
5 between each electrical device and each immediately adjacent electrical device, the ACE  
6 layers providing electrical connection through the package to at least contribute to a  
7 vertical electrical bus, and also conduct heat from the electrical devices;  
8 one or more spacer members that define one or more wells into which electrical  
9 devices can be placed, the spacer members each comprising a support for at least one  
10 electrical device; and  
11 a device for applying a releasable compressive load to each of the ACE layers.
- 1 2. The three-dimensional electrical device package of claim 1, further comprising at  
2 least one substrate for supporting and electrically connecting to the electrical devices.
- 1 3. The three-dimensional electrical device package of claim 2, further comprising a  
2 layer of ACE electrically interconnected between the substrate and the electrical device  
3 closest to the substrate.
- 1 4. The three-dimensional electrical device package of claim 2, wherein the substrate  
2 comprises a printed circuit board.
- 1 5. The three-dimensional electrical device package of claim 1, wherein the spacer  
2 members are electrically connected to the vertical bus.

- 1 6. The three-dimensional electrical device package of claim 5, wherein the electrical  
2 connection of the spacer members are accomplished using ACE.
- 1 7. The three-dimensional electrical device package of claim 1, wherein the spacer  
2 members further comprise a heat-conductive element within the support, to conduct heat  
3 laterally away from the electrical device.
- 1 8. The three-dimensional electrical device package of claim 7, wherein the spacer  
2 members further comprise electrical conductors in electrical contact with the supported  
3 device.
- 1 9. The three-dimensional electrical device package of claim 7 further comprising a  
2 heat-exchange device coupled to the heat-conductive elements.
- 1 10. The three-dimensional electrical device package of claim 9, wherein the heat-  
2 exchange device comprises one or more heat pipes.
- 1 11. The three-dimensional electrical device package of claim 9, wherein the heat-  
2 exchange device comprises one or more heat sinks.
- 1 12. The three-dimensional electrical device package of claim 9, wherein the heat-  
2 exchange device comprises a heat exchanger employing a flowing liquid.
- 1 13. The three-dimensional electrical device package of claim 10, wherein the device  
2 for applying a releasable compressive load is coupled to at least one heat pipe.
- 1 14. The three-dimensional electrical device package of claim 1, wherein the spacer  
2 members carry electrical signals.
- 1 15. The three-dimensional electrical device package of claim 14, wherein the package  
2 comprises a number of vertically-adjacent layers, each layer comprising a spacer  
3 member.

1 16. The three-dimensional electrical device package of claim 15, wherein ACE layers  
2 electrically interconnect the vertically-spaced spacer members.

1 17. The three-dimensional electrical device package of claim 1, wherein the spacer  
2 members comprise vertically thickened portions outside of the stack area, to create wells  
3 for the electrical devices.

1 18. A compliant interconnect for compactly, releasably packaging vertically-spaced  
2 electrical devices, comprising:

3 at least one substrate for supporting and electrically connecting to the electrical  
4 devices;

5 a series of vertically-adjacent spacer members together defining a stack area in  
6 which the electrical devices are located, the spacer members each comprising a support  
7 layer spanning the well, and supporting and electrically connecting to at least one  
8 electrical device;

9 a layer of ACE between each spacer member and each immediately adjacent  
10 spacer member;

11 a layer of ACE between the substrate and the spacer member closest to the  
12 substrate;

13 wherein the ACE layers provide electrical connection through the package, and  
14 also conduct heat from the electrical devices; and

15 a device for applying a compressive load to each of the ACE layers.

1 19. The compliant interconnect of claim 18, wherein the spacer members comprise  
2 vertically thickened portions outside of the stack area, to create wells for the electrical  
3 devices.

1 20. The compliant interconnect of claim 18, wherein at least one spacer member  
2 further comprises a heat-conductor for carrying heat away from the supported device.

3 21. The compliant interconnect of claim 20 further comprising a heat sink in thermal  
4 contact with the one or more of the heat conductors of one or more of the spacer  
5 members, to help dissipate heat from the devices.

1 22. The compliant interconnect of claim 20 further comprising one or more heat pipes  
2 in thermal contact with one or more of the spacer members, to help dissipate heat from  
3 the spacer members.

1 23. The compliant interconnect of claim 20, further comprising a heat exchanger  
2 employing a flowing liquid in thermal contact with one or more of the spacer members.

1 24. A three-dimensional electrical device package for compactly packaging  
2 vertically-spaced electrical devices, comprising:

3 a plurality of vertically-spaced electrical devices;

4 a layer of anisotropic conductive elastomer (ACE) electrically interconnecting  
5 each electrical device to each immediately adjacent electrical device, the ACE layers  
6 providing electrical connection through the package to at least contribute to a vertical  
7 electrical bus, and also conduct heat from the electrical devices;

8 one or more support layers that each support and electrically connect to at least  
9 one electrical device, the support layers comprising a heat-conductive element, to  
10 conduct heat laterally away from the supported electrical devices;

11 one or more heat pipes thermally coupled to the heat-conductive elements of the  
12 support layers; and

13 a device for applying a releasable compressive load to each of the ACE layers.

1    25.    The three-dimensional electrical device package of claim 24, wherein the device  
2    for applying a releasable compressive load is mechanically coupled to at least one of the  
3    heat pipes.